

What is claimed is:

1. A plasma processing apparatus for processing an object to be processed using a plasma, comprising:

a processing chamber defining a processing cavity  
5 for containing an object to be processed and a process gas therein;

a microwave radiating antenna having a microwave radiating surface for radiating a microwave in order to excite a plasma in the processing cavity; and

10 a dielectric body provided so as to be opposed to the microwave radiating surface;

wherein a distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which 15 is represented with a wavelength of the microwave being a distance unit, is determined to be in a range satisfying an inequality

$$0.7 \times n/4 \leq D \leq 1.3 \times n/4 \quad (n \text{ being a natural number}).$$

2. A plasma processing apparatus as claimed in claim 20 1, in which the distance D is determined to be in a range satisfying an inequality

$$0.7 \times n/2 \leq D \leq 1.3 \times n/2 .$$

3. A plasma processing apparatus as claimed in claim 1, in which the dielectric body is a plate-shaped member 25 disposed in such a manner that a distance between the

dielectric plate and the plasma radiating surface is substantially zero, and a thickness d of the dielectric plate represented with the wavelength of the microwave being a distance unit is determined to be in a range  
5 satisfying an inequality

$$0.7 \times n/4 \leq d \leq 1.3 \times n/4 \quad (n \text{ being a natural number}).$$

4. A plasma processing apparatus as claimed in claim 3, in which the thickness d is determined to be in a range satisfying an inequality

$$10 \quad 0.7 \times n/2 \leq d \leq 1.3 \times n/2 .$$

5. A plasma processing apparatus as claimed in claim 1, in which

the microwave radiating antenna is a radial line slot antenna having a number of slots formed and  
15 distributed in the microwave radiating surface thereof for radiating the microwave, and

a part of the number of slots is closed so as to uniformize the plasma generated in the processing cavity in a plane.

20 6. A plasma processing apparatus as claimed in claim 5, in which

the number of the slots are concentrically arranged in the microwave radiating surface, and

one per six or three slots in the peripheral  
25 direction of the slots arranged in the outermost

peripheral part are closed.

7. A plasma processing method for processing an object to be processed using a plasma, comprising the steps of:

    putting an object to be processed and

5     a process gas into a processing cavity defined in a processing chamber;

    radiating a microwave for exciting a plasma from a microwave radiating antenna having a microwave radiating surface to the processing cavity;

10     providing a dielectric body so as to be opposed to the microwave radiating surface; and

    determining a distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which  
15     is represented with a wavelength of the microwave being a distance unit, to be in a range satisfying an inequality

$$0.7 \times n/4 \leq D \leq 1.3 \times n/4 \quad (n \text{ being a natural number}).$$

8. A plasma processing method as claimed in claim

7, in which the step of determining the distance D includes a step of determining the distance D in a range satisfying an inequality  
20

$$0.7 \times n/2 \leq d \leq 1.3 \times n/2 .$$